Remarks

Claims 1-3 are currently pending in the application. In the Office Action dated January 19, 2011, claims 1-3 are rejected.

In the instant Amendment, claim 1 has been amended for editorial purposes.

Accordingly, no new matter has been introduced by the present amendment. Entry of the foregoing amendment and consideration of the following remarks are respectfully requested.

Claim rejection under 35 U.S.C. §103

Claims 1-3 are rejected under 35 U.S.C. §103(a) as being unpatentable over JP 2001-279412 ("JP '412") in view of U.S. Patent No. 4,437,905 to Nitto, et al. ("US '905").

As discussed in previous responses (*see* Amendments dated August 20, 2009 and May 10, 2010), the present invention provides a process for production of a high strength galvannealed steel sheet, which comprises continuously hot-dip galvanized high strength steel sheet having a content of Si of 0.4 to 2.0 wt % by a hot-dip galvanized steel sheet production system using an all radiant tube type annealing furnace. Applicants respectfully submit that, as is well known in the art, an all radiant tube type annealing furnace does not include an oxidizing zone. For example, according to JP 2009-209397 (submitted herewith in an information disclosure statement):

> … Other than DEF (Direct Fire Heating Furnace) and NOF (Non Oxygen Furnace), a steel sheet is not oxidized in a heating zone in an all radiant tube type CGL (Continuous Galvanizing Line), because no oxidizing zone is there in a heating furnace just before annealing furnace….

(see, paragraph [0018]). Thus, the presently claimed process does not involve oxidizing the steel sheet in an oxidizing zone.

Furthermore, according to Nissin Technical Report No. 78 (1998), pages 1-8, entitled: Effect of reduction-heating conditions on wetting characteristics with molten zinc of 1F-steels containing Mn and P (submitted herewith in an information disclosure statement):

> …Although NOF (Non-Oxygen Furnace) is necessary in an oxidation-reduction type CGL (Continuous Galvanizing Line), no NOF is applied to all-radiant-tube type CGL, which employs an indirect-heating and hydrogen-reduction method…

(see, p. 2, left hand column, ll. 1-4 of the Report). Thus, the process of the present invention involves continuously hot-dip galvanizing the high strength steel sheet without passing it through an oxidizing zone.

The present process controls the atmosphere of the reducing zone of the all radiant tube type annealing furnace such that it will not cause iron to oxidize but causes internal oxidation of SiO_2. More specifically, in the process of the invention, the conditions are provided to cause internal oxidation of SiO_2 without generating iron oxides to reduce SiO_2 formation on the surface of a steel sheet, e.g., by controlling $\log(PCO_2/PH_2)$ to ≤ -0.5, $\log(PH_2O/PH_2)$ to ≤ -0.5, and $\log(P_T/PH_2)$ to $-3 \leq \log(P_T/PH_2) \leq -0.5$ when using the all radiant tube type annealing furnace, and also making the atmosphere of a reducing zone to include a balance of N_2, H_2O, O_2, CO_2, CO, and unavoidable impurities. In particular, Applicants have discovered that the formation of iron oxide can be prevented by expanding the range of $\log(PH_2O/PH_2)$ to ≤ -0.8 in JP '412 (*see* JP '412, the abstract) to the claimed range of $\log(PH_2O/PH_2)$ to ≤ -0.5 by adding CO_2 and CO. In other words, the presence of CO_2 and CO makes it possible to eliminate the formation of iron oxide at $\log(PH_2O/PH_2)$ to ≤ -0.5.

In contrast, JP '412 teaches generating Fe oxide of several thousands Å in an oxidizing zone to suppress the formation of Si oxides on the surface (*see* JP '412, paragraphs [0021]). According to JP '412, the steel is then reduced in a reducing zone having an atmosphere with N_2 gas containing 1-70% of H_2 to reduce Fe oxide and cause internal oxidation of SiO_2. In addition, according to JP '412, the reason for having made $\log (PH_2O/PH_2)$ less than -0.8 is because the oxide film of the iron generated cannot be reduced if -0.8 is exceeded (*see* JP '412, paragraphs [0022] and [0023]). Thus, JP '412 teaches a conventional process which uses a furnace wherein iron is oxidized in an oxidizing zone, and thereafter, the generated iron oxide is reduced in a reducing zone, that is different from the production process of the present invention.

US '905 teaches a process for continuously annealing a cold-rolled low carbon steel strip, where the steel strip is rapidly heated in an oxidizing zone with gaseous combustion prepared at a combustion air ratio of 0.8 or more but less than 1.0 in a direct fired furnace to cause the thickness of a layer of oxides on the surface of the steel strip not exceed 1000 Å, by maintaining the temperature in a reducing atmosphere comprising 4% or more of hydrogen and the balance nitrogen (*see* US '905, the abstract, and col. 3, ll. 39-49). US '905 also teaches a process utilizing an oxidizing zone to first generate a layer of iron oxides on the steel strip

surface, and a reducing zone containing N_2 and H_2 to reduce iron oxides. For example, referring to Fig. 2 of US '905 (col. 7, line 64 to col. 8, line 2), where it is described that the steel strip is oxidized in the zone above Curve (I) due to the reaction of iron with H_2O and in the zone above Curve (II) due to the reaction of iron with CO_2, in both cases, iron oxide is generated. Then, the steel strip is reduced in the zone below Curve (I) due to the reaction of iron oxide with H_2O and in the zone below Curve (II) due to the reaction of iron oxide with CO. Thus, US '905 does not cure the deficiencies of JP '412.

Both of the cited references (JP '412 and US '905) disclose a process that uses an oxidizing zone to generate Fe oxide. None of the cited references discloses or suggests a process that does not use an oxidizing zone. One skilled in the art would not have arrived at the process for a high strength galvannealed steel sheet of the present invention based on the disclosure of JP '412 and the disclosure of US '905. For at least these reasons, the rejection of claims 1-3 under 35 U.S.C. § 103(a) over JP '412 in view of US '905 cannot stand and should be withdrawn.

In view of the foregoing remarks, Applicants respectfully submit that the present application is in condition for allowance. Early and favorable action by the Examiner is earnestly solicited. If the Examiner believes that issues may be resolved by a telephone interview, the Examiner is invited to telephone the undersigned at the number below.

Respectfully Submitted,

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